Heat loss from a building

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SOLUTION Page 1

STEP 1

Determine the areas of all the external surfaces of the building (m^2) and the total volume of the space (m^3)

FLOOR = ROOF = 8.5m x 12.5m **A = 106.25m²**

TOTAL EXTERNAL WALL AREA =
2 x (8.5m x 3.2m) + 2 x (12.5m x 3.2m)
54.4m² + 80.0m² **A = 134.4m²**

GLAZING: 25% of the total external walls are glazed
= 0.25 x 134.4m² **A = 33.6m²**

DOORS **A = 4m²**

EXTERNAL SOLID WALL AREA =
Total external wall area - Glazing - Doors
134.4m² - 33.6m² - 4m² **A = 96.8m²**

VOLUME OF THE SPACE = Length x Width x Height
12.5m x 8.5m x 3.2m **V = 340.0m³**

STEP 2

Determine the temperature difference inside to outside of the dwelling.
$\Delta T = T_1 - T_2 = 21^oC - (-4^oC)$
$\Delta T = 25^oC$ = **25K**

STEP 3

Determine the Fabric Heat Loss by completing the table.

Fabric Heat Loss $Q_F = UA\,\Delta T$ (W)

Element	U (W/m²K)	A (m²)	ΔT (K)	Heat Loss (W)
Walls	0.35	96.8	25	847
Floor	0.25	106.25	25	664
Roof	0.25	106.25	25	664
Glazing	2.2	33.6	25	1848
Doors	0.8	4.0	25	80
			TOTAL	**4103 (W)**

STEP 4

Determine the Ventilation Heat Loss from the equation:

$Q_V = \frac{1}{3}\,N\,V\,\Delta T$ (W)

$= \frac{1}{3} \times 0.5 \times 340 \times 25$

= **1402 (W)**

STEP 5

Add the Fabric and Ventilation Heat Loss figures to determine the Total Heat Loss:

$Q = Q_F + Q_V$ = 4103 + 1402 (W)
= **5505 (W)**
or approximately 5.5 (kW)

Heat loss from a building

SOLUTION Page 2

A flat roofed dwelling measures 8.5m x 12.5m in plan and is 3.2m high.
The total external wall area includes 25% area of glazing and has front / back doors with a total area of 4m^2

The thermal transmittence (U-values) of the various elements of the building comply with current building regulations and are as follows:

Element	**U-value** (W/m^{2}K)
Walls	0.35
Floor	0.25
Roof	0.25
Glazing	2.2
Doors	0.8

The air infiltration or ventilation rate of the building is 0.5 air changes per hour.
The winter internal and external air temperatures are 21^{o}C and -4^{o}C respectively.

Calculate the total heat loss for the dwelling in winter conditions.

Fabric Heat Loss $Q_F = UA\,\Delta T$ (W)

Element	U (W/m^{2}K)	A (m^2)	ΔT (K)	Heat Loss (W)
Walls	0.35	96.8	25	847
Floor	0.25	106.25	25	664
Roof	0.25	106.25	25	664
Glazing	2.2	33.6	25	1848
Doors	0.8	4.0	25	80
			TOTAL	4103 (W)

U	=	Thermal transmittance of building element (W/m^{2}K)
A	=	Surface area of building element (m^2)
ΔT	=	Temperature difference inside to outside (K)
N	=	Number of fresh air changes per hour
V	=	Volume of the inside space (m^3)
K	=	Degrees Kelvin
W	=	Watts

Ventilation Heat Loss $Q_V = \frac{1}{3}\,N\,V\,\Delta T$ (W) = 1402 (W)

Total Dwelling Heat Loss $Q = Q_F + Q_V$ = 5505 (W)

How might the heat loss from the dwelling be reduced to move toward a zero carbon emissions building?

Consider the major sources of heat loss from the dwelling.

Where might it be possible to reduce these values?

Major sources of heat loss are:
1. Glazing 2. External walls 3. Ventilation

How might this be achieved?

1. Use triple glazing to reduce the U-value
2. Increase thickness of wall insulation
3. Improve the airtightness of the building